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(54) ELECTRIC DOUBLE-LAYER CAPACITOR

(57)Abstract:

PURPOSE: To improve a capacitor output capacity by a method wherein the specific surface area of an active carbon material used as a cathode and the specific surface area of an active carbon material used as an anode are respectively specified and, further, the specific surface area of the active carbon material used as the cathode is smaller than the specific surface area of the active carbon material used as the anode.

CONSTITUTION: An electric double-layer capacitor has two electrodes composed of active carbon materials. The specific surface area of the active carbon material used as a cathode is 500m2/g-1500m2/g and the specific surface area of the active carbon material used as an anode is 1000m2/g-2500m2/g and, further, the specific surface area of the active carbon material used as the cathode is smaller than the specific surface area of the active carbon material used as the anode. Active carbon fiber is employed as the active carbon material. Or, the ratio of the weight of the active carbon material used as the cathode to the weight of the active carbon material used as the anode is to be 0.4-0.9. With this constitution, the volume of the cathode can be reduced and the cost per unit capacity can be reduced.

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* NOTICES *

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2.**** shows the word which can not be translated.
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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to activated carbon material especially activated carbon, and the improved electric double layer capacitor that uses an activated carbon fiber for a polarizable electrode. More, since the electric double layer capacitor of this invention used the activated carbon material from which specific surface area differs for the polarizable electrode, there is an advantage from which the output per high capacity is obtained in a detail.
[0002]
[Description of the Prior Art] In recent years, development of the electric double layer capacitor which used activated carbon material with a big specific surface area (activated carbon, an activated carbon fiber, etc. are summarized here, and it is defined as activated carbon material) as a polarizable electrode is performed positively. An electric double layer capacitor is a mass capacitor using the electric double layer formed between an activated carbon material front face and the electrolytic solution.
[0003] in order that an electric double layer capacitor may not follow a chemical reaction like the usual rechargeable battery on charge and discharge, as compared with a rechargeable battery, internal resistance boils it markedly, and it has the advantage in which power density is comparatively [with low energy density / low] high, and high current discharge is possible. Furthermore, it also has the description that no limit of the count of charge and discharge is.
[0004] However, it is that an output capacitance low [the greatest trouble of an electric double layer capacitor] energy density and high is difficult to get, and various examination is made until now that this point should be improved. Moreover, in the electric double layer capacitor which uses activated carbon material as a polarizable electrode, the examination from Men of the electrolytic solution is also made using aquosity liquid, such as a case where the nonaqueous nature (organic system) liquid made to dissolve electrolytes, such as lithium perchlorate, in organic system polar solvents, such as propylene carbonate, as the electrolytic solution is used, a sulfuric-acid water solution, and a potassium-hydroxide water solution.
[0005]
[Problem(s) to be Solved by the Invention] Although there will be an object for engine starting of an automobile as an application of the capacitor expected from now on, in the application for which such high current discharge is needed, the above-mentioned electric double layer capacitor is made promising, and improvement in the engine performance is demanded.
[0006] It is said that the capacitor capacity per unit weight of the activated carbon material used for the polarizable electrode of an electric double layer capacitor is generally proportional to the specific surface area of activated carbon material, and in order to raise the capacitor capacity per the unit weight, it is necessary to use activated carbon material with a high specific surface area.
[0007] On the other hand, when the specific surface area of activated carbon material is raised, the pack density of the activated carbon material itself falls. For this reason, in order to make [most] capacitor capacity per unit volume of activated carbon material, it is already known that the optimal specific

surface area exists (JP,5-82395,A). However, specific surface area of the activated carbon used as the material of an electrode needed to be carried out to more than 2000m2 / g, yield was extremely low and there was a problem to which the volume becomes large.

[0008]

[Means for Solving the Problem] this invention person changes the specific surface area of the activated carbon material used for a polarizable electrode, as a result of examining various the above-mentioned technical problems. By finding out the optimal specific surface area of the activated carbon material which makes smaller than it which is used for a positive electrode specific surface area of the activated carbon material used especially for a negative electrode, and is used for two electrodes Even if it used the activated carbon material of a comparatively small specific surface area, it came to complete a header and this invention for it becoming possible to raise the capacitor output capacitance of per a unit weight (capacity) of a capacitor.

[0009] That is, this invention offers an electric double layer capacitor with a specific surface area of the activated carbon material which the specific surface area of the activated carbon material which the specific surface area of the activated carbon material which uses for a negative electrode the electrode which consists of :** activated carbon material in the electric double layer capacitor used for two poles uses for 500m2 / g-1500m2 / g, and a positive electrode is 1000m2 / g-2500m2 / g, and is used for a negative electrode smaller than the specific surface area of the activated carbon material used for a positive electrode. Moreover, it has the description also at the point that ** activated carbon material is an activated carbon fiber. Moreover, the weight rate of the activated carbon material which uses for a negative electrode the electrode which consists of ** activated carbon material in the electric double layer capacitor used for two poles offers the electric double layer capacitor which are 0.4-0.9 to the activated carbon material used for a positive electrode.

[0010] Hereafter, this invention is explained to a detail. The electric double layer capacitor of this invention is low internal resistance, and since the capacitor capacity of per a unit weight (capacity) of a capacitor is high and the amount of accumulation-of-electricity energy is large, it fits especially the application which needs the high current discharge for engine starting of an automobile etc. In addition, a specific surface area here is measured with a BET adsorption method, and points out what rounded at least that of 10 off in consideration of the accuracy of measurement, and was displayed from the digit of 100.

[0011] Drawing 5 is the mimetic diagram showing the typical structure of the electric double layer capacitor of this invention. drawing 5 -- setting -- 1 -- for a stainless steel lid and 4, as for an obturation object and 6, a stainless case and 5 are [a positive electrode and 2 / a negative electrode and 3 / a separator and 7] the electrolytic solutions.

[0012] (A) Specific surface area of the activated carbon material used for a polarizable electrode : although the activated carbon material with same positive electrode of an electric double layer capacitor and negative-electrode two poles was used conventionally, this invention person reached this invention, as a result of repeating examination about change of the capacitor capacity at the time of changing the specific surface area of the activated carbon material used for two poles.

[0013] In the polarizable electrode which consists of activated carbon material which constitutes the electric double layer capacitor of this invention namely, the output capacitance per unit weight of a capacitor The specific surface area of the activated carbon material used for a negative electrode 500m2 / g-1500m2 / g, It is characterized by the specific surface area of the activated carbon material which the specific surface area of the activated carbon material used for a positive electrode is 1000m2 / g-2500m2 / g, and is used for a negative electrode being smaller than the specific surface area of the activated carbon material used for a positive electrode.

[0014] In this invention, although it cannot be solving clearly about a good reason if the activated carbon material by the side of a negative electrode makes specific surface area lower than a positive-electrode side, it is presumed that the magnitude of the ion which carries out adsorption and desorption to activated carbon material is related. That is, it is because it is thought that the activated carbon material used for a negative electrode since size is small shows the dope capacity for the small thing of

the pore size from which specific surface area has not developed compared with the ion kind with which the ion kind doped by the negative-electrode front face to a positive electrode is doped by the positive electrode regardless of the electrolytic solution of a non-drainage system and a drainage system to be also high.

[0015] the specific surface area of the activated carbon material used for a negative electrode -- 500m2 / g-1500m2 / g -- it is preferably good 500m2 / g-1300m2 / g, and that they are 600-1200m2 / g more preferably. The specific surface area of capacity of the activated carbon material used for a negative electrode is small at under 500m2 / g, and since the increment in capacity is not seen even if it will enlarge specific surface area more than it on the other hand, if this specific surface area exceeds 1500m2 / g, but a consistency falls on the contrary, it is not desirable.

[0016] Namely, it is better to use activated carbon material with a specific surface area small as negative-electrode material as mentioned above, when the capacitor capacity per weight of activated carbon material is the same, in order to raise the capacitor capacity per volume of an electric double layer capacitor. This is because the consistency of the appearance of activated carbon material becomes so high that specific surface area is small and the bulk density of an electrode also becomes high.

[0017] moreover, the specific surface area of the activated carbon material used for a positive electrode -- 1000-2500m2 / g -- it is preferably good 1000-2300m2 / g, and that it is 1200-2200m2/g more preferably. The specific surface area of capacity of the activated carbon material used for a positive electrode is small at under 1000m2 / g, and if this specific surface area, on the other hand, exceeds 2500m2 / g, the yield of this activated carbon material becomes extremely small, and it is not desirable on real use.

[0018] As a specific surface area of the activated carbon material used for a negative electrode when an aquosity solution like a sulfuric-acid water solution as the electrolytic solution is used, it is good to use the thing about 1200-1600m2 / g as 500-1200m2 / g, and a specific surface area of the activated carbon material which uses the thing of 600-1000m2 / g for a positive electrode especially preferably again. When using a nonaqueous nature solution like the propylene carbonate solution of lithium perchlorate as the electrolytic solution, it is desirable to use the thing about 1800-2200m2 / g as activated carbon material of a positive electrode, and to use the thing about 1200-1600m2 / g as activated carbon material of a negative electrode.

[0019] Thus, in order for the activated carbon material which constitutes a polarizable electrode to act efficiently, they are requirements with required the specific surface area of the activated carbon material used for a negative electrode being smaller than the specific surface area of the activated carbon material used for a positive electrode. Activated carbon, an activated carbon fiber, etc. are contained in the activated carbon material used for this invention, and the shape of powder and a grain etc. can use the thing of the configuration of arbitration, such as a staple fiber, Mild, and a filament, for it as an activated carbon fiber as a gestalt of this activated carbon again.

[0020] Activated carbon points out carbonization and the thing which carried out activation with a conventional method here for the synthetic resin obtained from natural products, such as sawdust and a coconut shell, coal, etc., such as an aromatic series system polycyclic condensate and phenol resin. An activated carbon fiber points out carbonization and the thing which carried out activation with a conventional method here for fiber, such as a pitch of coal, petroleum, etc., a phenol system, acrylic, an aromatic polyamide system, and a cellulose system.

[0021] Especially in this invention, although not limited to these raw materials, especially being used preferably is an activated carbon fiber. Adjustment of specific surface area and adjustment of pore distribution can perform an activated carbon fiber easily, and manufacture of what has a big specific surface area is also easy for it. Moreover, the activated carbon fiber also has the advantage of being easy to fabricate in a sheet-like gestalt.

[0022] In addition, when specific surface area is small, in what is 800m2 / g grade, without performing the so-called required activation processing on manufacture of the above-mentioned activated carbon fiber, it is enough just to perform low-temperature heat treatment (dry distillation) of about 600-1000 degrees C, and such a carbonization processing article can also be used for this invention.

[0023] In order to manufacture the activated carbon material from which the specific surface area concerning this invention differs variously, the activated carbon material of the specific surface area to mean is obtained by changing various temperature, time amount, etc. in the case of activation especially. The raw material of the activated carbon fiber used in this invention is good to use the thing of a phenol system or a pitch system, especially a petroleum pitch system preferably. When these raw materials are used, are easy to adjust the specific surface area of an activated carbon fiber, and activation yield is also high, and it is advantageous.
[0024] Although especially the approach of producing an activated carbon material electrode in this invention is not limited, the manufacture technique of the activated carbon material electrode known conventionally can be used as it is. For example, in the case of activated carbon, what sank in the electrolytic solution after carrying out activation, foaming and carbonization, and is mentioned in what mixed the thing, and the powder and sulfuric-acid water solution of activated carbon which sintered the activated carbon of the shape of the sheet-like object rolled out in the shape of a sheet, and powder, made the shape of a paste, and carried out the laminating to the aluminum substrate at the shape of a thin film (JP,63-244609,A, JP,2-174210,A), and a phenol resin Plastic solid.
[0025] Moreover, in the case of an activated carbon fiber, what is applied the shape of a nonwoven fabric and in the shape of textile fabrics, the thing (JP,64-82514,A) which uses the textile fabrics of an activated carbon fiber and sinks in the electrolytic solution can be mentioned.
[0026] (B) Electrolytic solution : with the nonaqueous nature system electrolytic solution which can be used for this invention, the thing of aprotic and a high dielectric constant is used as a solvent. As an example, propylene carbonate, gamma-butyrolactone, dimethyl sulfoxide, dimethyl formamide, an acetonitrile, ethylene carbonate, a tetrahydrofuran, dimethoxyethane, etc. can be mentioned. These nonaqueous nature solvents can be used as a kind or two sorts or more of mixed solvents.
[0027] Furthermore, as an electrolyte used in these nonaqueous nature solvent, the salt of a cation and anions, such as a metaled cation, the 4th class ammonium cation, and a carbonium cation, can be mentioned. as the anion used here -- for example, ClO4-, BF4-, PF4-, PF6-, and AsF6- etc. -- it is mentioned. as a concrete electrolyte -- for example, LiClO4, BuN-ClO4, and NaBF4 etc. -- it can mention.
[0028] With the aquosity system electrolytic solution used for this invention, water is used as a solvent. as the electrolyte used for the aquosity system electrolytic solution -- for example, NaCl, NaOH, KOH and HCl, and H2 SO4 etc. -- it can mention. Although especially the drainage system electrolytic solution used for this invention is not limited, it is good to use a sulfuric-acid water solution preferably especially. When a sulfuric-acid water solution is used, since the capacitor capacity per unit weight of activated carbon material becomes high also in various kinds of electrolytic solutions, it is desirable.
[0029] As the electrolytic solution used for this invention, anything of a nonaqueous nature (organic polar solvent) system or an aquosity system can be used. Especially, when a drainage system is used as the electrolytic solution, it is desirable also from the cost side of negative-electrode material. Moreover, when an aquosity solution, especially a sulfuric-acid water solution are used as the electrolytic solution, improvement in the output capacitance of a capacitor is large.
[0030] Although especially the concentration of the electrolyte in the electrolytic solution is not limited, when it is an aquosity system, it is good to consider as 20 % of the weight - 40 % of the weight preferably 10 % of the weight to 60% of the weight. the concentration of the electrolyte in the case of a nonaqueous nature solvent -- 0.5M/L- the range of 1 M/L - 2 M/L is preferably desirable 3 M/L.
[0031] (C) The weight ratio of the activated carbon material used for a polarizable electrode : although characterized by using the activated carbon material from which specific surface area differs on two poles as mentioned above in this invention again or even when this invention is out of range, using the activated carbon material of the same specific surface area as two poles like the conventional technique etc. The weight of a capacitor or the output capacitance per capacity can also be raised by decreasing the weight of the activated carbon material of a negative electrode sharply as compared with the weight of the activated carbon material of a positive electrode.
[0032] Of course, if the above-mentioned case is applied in the case of this invention, improvement in

the output capacitance of much more capacitor can be aimed at. That is, it is desirable 0.4 to 0.9 and to set preferably to 0.5-0.8 the weight rate of the activated carbon material used for a negative electrode to the activated carbon material used for a positive electrode.
[0033] If capacity is small at less than 0.4 and the weight of the activated carbon material of a negative electrode exceeds 0.9 preferably on real use to the weight of the activated carbon material of a positive electrode, even if the weight of the activated carbon material of a negative electrode will increase, the output capacitance of a capacitor hardly improves and it is meaningless. When an aquosity solution like a sulfuric-acid water solution as the electrolytic solution is used, as for the amount of negative-electrode activated carbon material, it is desirable that it is 0.7 or less [0.5 or more] to the activated carbon material of a positive electrode.
[0034] Moreover, when propylene carbonate and a nonaqueous nature solution like lithium perchlorate are used as the electrolytic solution, as for the amount of the activated carbon material of a negative electrode, it is desirable that it is [or more 0.4] 0.9 or less.
[0035]
[Function]
** Since the bulk density becomes high while specific surface area of the activated carbon material used for a negative electrode can be made small compared with the former and yield improves,-izing of the negative electrode itself can be carried out [whenever / high bulk density] more. Therefore, the volume of the negative electrode occupied in an electric double layer capacitor can be made small.
** Since weight of the activated carbon material used for a negative electrode can be lessened further, the volume which the negative electrode itself occupies can be made small.
[0036] ** Within the same capacity as the part former which became small, the volume of a negative electrode can increase the weight of the activated carbon material of a positive electrode, and the rise of the capacitor capacity which is about 30 percent of it is attained.
** It becomes possible to design the optimal specific surface area and the optimal amount of the activated carbon material used which makes small specific surface area of the activated carbon material of a negative electrode, and is used for a positive electrode and negative-electrode two poles, and the cost reduction per capacity of a capacitor becomes possible.
[0037]
[Example] Although an example explains this invention still more concretely below, this invention is not limited to it.
(Example 1) Spinning of the optical-isotropy pitch of 270 degrees C of softening temperatures which heat-treated and obtained the cracked residue oil of <change of use [of an aquosity liquid-petroleum pitch system activated carbon fiber] and specific surface area> petroleum was carried out using the mouthpiece which has a spinning hole with a diameter of 0.2mm in 1,000 single tiers into the slit with a width of face of 2mm, and pitch fiber was manufactured. The uptake part attracted this spun pitch fiber from the tooth back of the belt which consisted of wire gauzes made from stainless steel whose number is 35, and carried out uptake on the belt.
[0038] After performing non-deliquesce processing for the mat-like object of the obtained pitch fiber by part for average programming-rate/of 4 degrees C in air, slight carbonization processing was performed at 600 degrees C in nitrogen gas. Using this slight carbonization yarn, activation processing was performed for 10 minutes - 50 minutes among the steam in the 800 degrees C - 950 degrees C temperature requirement, and the various petroleum pitch system activated carbon fibers of specific surface area of 400m 2 / g-2500m2 / g were produced.
[0039] 40mg of activated carbon fibers with the specific surface area of 1800m2 / g obtained by the above-mentioned technique was used as the positive electrode, the electric double layer capacitor of the structure shown in a negative electrode at drawing 5 R> 5 using 10mg of activated carbon fibers of 400m2 / g was made as an experiment, and the capacity was measured. Thus, by using the activated carbon fiber of the large excessive amount of 40mg for a positive electrode to a negative electrode, the capacity of a capacitor will receive effect only in the activated carbon of a negative electrode, and the examination of the optimal activated carbon fiber for negative electrodes of it is attained.

[0040] After the activated carbon fiber was immersed in the sulfuric-acid water solution, using 30% of the weight of a sulfuric-acid water solution as the electrolytic solution, by [this] performing reduced pressure processing a condition, the electrolytic solution was completely infiltrated into the activated carbon fiber, and the capacitor was produced. Thus, it was 20 F/g when capacity was measured using the capacitor made as an experiment.
[0041] The capacitor capacity per 1g of activated carbon fibers points out the capacity of the capacitor at the time of using 0.5g for a positive electrode and using a 0.5g activated carbon fiber for a negative electrode. For this reason, it considered as the capacity per 1g of activated carbon fibers by breaking the capacity measured in this experiment by 20mg (amount-used x2 of the activated carbon fiber of a negative electrode).
[0042] Next, using the activated carbon fiber which has the specific surface area of 500m2 / g in a negative electrode 10mg, the positive electrode produced the electric double layer capacitor like the above by 40mg of activated carbon fibers of 1800m2 / g, and obtained the capacity of 39 F/g. Various specific surface area of the activated carbon fiber similarly used for a negative electrode was changed hereafter, and capacitor capacity was measured. The result was shown in drawing 1 .
[0043] That is, drawing 1 shows change of the capacitor capacity when changing various specific surface area of the activated carbon fiber used for the negative electrode at the time of aquosity electrolytic-solution use. according to drawing 1 , since it hit, when [by which the specific surface area of the activated carbon fiber used for a negative electrode exceeded 500m2 / g] specific surface area was more than 1000m2 / g, even if capacitor capacity increased quickly, specific surface area reached the capacity of 57 F/g in 800m2 / g, and specific surface area increased, there were very few increments in capacity, and specific surface area exceeded 1200m2 / g -- since it hit, it took about 1 law.
[0044] The effect affect the capacitor capacity of the specific surface area of the activated carbon fiber of the positive electrode in a sulfuric-acid water-solution system using the same technique was considered. That is, specific surface area used 40mg of petroleum pitch system activated carbon fibers of 1000m2 / g for the negative electrode, and 10mg of each capacitor capacity was measured using the activated carbon fiber which has various specific surface area in a positive electrode. The result was also shown in drawing 1 . When the specific surface area of an activated carbon fiber exceeds 1000m2 / g, under [almost fixed from the hit where capacity increased quickly from from and specific surface area became 1600m2 / g].
[0045] (Example 2) Examination by the nonaqueous nature solvent system was performed by the same technique as an example 1 using the petroleum pitch system activated carbon fiber obtained in the <change of use [of a non-aquosity liquid-petroleum pitch system activated carbon fiber], and specific surface area> example 1. The propylene carbonate solution of the lithium perchlorate of 1 M/L was used for the used electrolytic solution. The measurement result of the effect of specific surface area exerted on a negative electrode and a positive electrode was shown in drawing 2 .
[0046] That is, drawing 2 shows change of the capacitor capacity when changing various specific surface area of the activated carbon fiber used for the negative electrode at the time of nonaqueous nature electrolytic-solution use. according to drawing 2 , the specific surface area of the activated carbon fiber used for the negative electrode exceeded 800m2 / g -- since it hit, capacitor capacity increased rapidly, and specific surface area exceeded 1400m2 / g -- since it hit, it became about 1 law, and in 2000m2 / g, it reached at 35 F/g. On the other hand, the capacity of a positive electrode increased as it increased from the hit where specific surface area exceeded 1600m2 / g and specific surface area increased, and when specific surface area was 2500m2 / g, it reached 30 F/g.
[0047] (Example 3) The effect of the amount of negative-electrode activated carbon fibers when using the activated carbon fiber of the same specific surface area as two poles was considered using the petroleum pitch system activated carbon fiber of the various specific surface area obtained in use and the change > example 1 of a quantitative ratio of the petroleum pitch system activated carbon fiber of the same specific surface area on < two poles.
[0048] The capacity was measured and 34 F/g was obtained, after having used 30% of the weight of the sulfuric-acid water solution as the electrolytic solution, using 20mg of activated carbon fibers of

1200m2 / g for the positive electrode and the negative electrode, respectively and making an electric double layer capacitor as an experiment.
[0049] Next, when the amount of activated carbon fibers of a negative electrode was decreased to 15mg and capacitor capacity was measured similarly, they were 34 F/g too. henceforth -- the same -- carrying out -- the amount of activated carbon fibers of a negative electrode -- one by one -- an about [1mg] ** -- when it carried out [****], and it went and measurement of capacitor capacity was repeated, most change did not have 11mg, but when reduced by half to 10mg, i.e., a positive electrode, capacitor capacity decreased to 30 F/g.
[0050] Thus, since it came to see reduction in capacity even if it decreased the amount of activated carbon fibers of a negative electrode to 11mg to 20mg of positive electrodes, the proper amount of a negative electrode was set to 11mg, and the ratio to a positive electrode was set to 11 / 20= 0.55. Similarly, the proper amount of the negative electrode in the case of the activated carbon fiber of various specific surface area was calculated. The result was shown in drawing 3 .
[0051] That is, drawing 3 is a graph which shows the inclination of change of the proper amount of the activated carbon fiber of a negative electrode, and change of specific surface area, when the activated carbon fiber of the same specific surface area as two poles is used. As shown in drawing 3 , when the activated carbon fiber of the same specific surface area was used, the proper amounts of the activated carbon fiber of a negative electrode to a positive electrode were 0.5-0.7. Furthermore, in the non-drainage system which used the propylene carbonate solution of lithium perchlorate as the electrolytic solution, the amount of activated carbon fibers of the proper negative electrode when using the activated carbon fiber of the same specific surface area as two poles was examined. The result was also shown in drawing 3 . The amounts of the activated carbon fiber of the proper negative electrode in this case were 0.4-0.9 to the activated carbon fiber of a positive electrode.
[0052] (Example 4) Melt spinning of the <change of use [of aquosity and a non-aquosity liquid-phenol system activated carbon fiber] and specific surface area> novolak system phenol resin (PRmade from Sumitomo DEYUREZU- 53195) was carried out at 130 degrees C. Spinning was performed the condition for 520m/in talkative [252], spinneret diameter 0.20mmphi, and rolling-up rate, and 1.90d non-hardened phenol resin fiber was obtained.
[0053] It was immersed in the mixed water solution which consists this non-hardened phenol resin system fiber of a hydrochloric acid and 15% of the weight of formaldehyde 20% of the weight at the room temperature, and the temperature up was started. After carrying out a temperature up to the temperature of 96 degrees C, it held at this temperature for 8 hours. Subsequently, it was immersed in the mixed water solution which consists of 2% of ammonia, and 50% of methanol at 70% for 1 hour. This fiber was taken out, rinsing and desiccation were performed and the hardened phenol fiber was obtained.
[0054] Fineness is 2.1d and this fiber had 2 and the physical properties of 40% of ductility of 19kg/mm on the strength. Activation was performed for this fiber on condition that the versatility in the combustion gas of a propane, and the phenol system activated carbon fiber with the specific surface area of 400-2500m2 / g was obtained. Using this activated carbon fiber, the sulfuric-acid water solution was used as the electrolytic solution, and when the capacity of a negative electrode and a positive electrode was calculated like the example 1, the almost same inclination as drawing 1 was shown.
[0055] that is, in negative-electrode capacity, the specific surface area of the activated carbon fiber used for a negative electrode exceeded 500m2 / g -- since it hit, capacitor capacity increased quickly and specific surface area exceeded 1200m2 / g -- since it hit, it took about 1 law. moreover, about positive-electrode capacity, when the specific surface area of the activated carbon fiber of a positive electrode exceeded 1000m2 / g, capacity increased quickly from from, and specific surface area was set to 1600m2 / g -- since it hit, it took about 1 law.
[0056] Furthermore, when examination in a non-drainage system was performed like the example 2, using the propylene carbonate solution of the lithium perchlorate of 1 M/L as the electrolytic solution, the almost same result as drawing 2 R> 2 was obtained. that is, the specific surface area of the activated carbon fiber which used negative-electrode capacity for the negative electrode exceeded 800m2 / g --

since it hit, capacitor capacity increased quickly, and specific surface area exceeded 1400m2 / g -- since it hit, it became about 1 law. On the other hand, the capacity of a positive electrode increased as it increased from the hit where specific surface area exceeded 1600m2 / g and specific surface area increased.

[0057] (Example 5) <Change of use [of aquosity and non-aquosity liquid-activated carbon] and specific surface area> coconut husks were used as the start raw material, activation processing was performed, and the activated carbon of the various specific surface area of specific surface area of 400-2000m 2 / g was obtained. The effect affect the capacity of the specific surface area of the activated carbon used for the negative electrode and positive electrode in an aquosity system and a nonaqueous nature system was measured like the example 1 and the example 2 using this activated carbon.

[0058] At this time, the electrode which consists of powdered activated carbon in the following procedures was produced. Namely, after adding propylene glycol to activated carbon powder as fluid lubrication material and mixing, it kneaded by adding PTFE aquosity dispersion (Daikin Industries, LTD. make D-1). After carrying out rolling shaping and carrying out hot air drying of this thing to a sheet with a thickness of 1mm, it considered as the electrode of an electric double layer capacitor. The result was almost the same as that of what was shown in drawing 1 and drawing 2 .

[0059] (Example 6) Like the <change of use [of the petroleum pitch system activated carbon fiber from which the specific surface area of two poles differs], and quantitative ratio> example 1, specific surface area used 20mg of petroleum pitch system activated carbon fibers of 1400m2 / g for the positive electrode, the thing of the specific surface area of 800m2 / g was used for the negative electrode, and capacity was measured, carrying out sequential reduction of the amount of activated carbon fibers used for a negative electrode one by one like an example 3 from 20mg. The result was shown in drawing 4 R> 4.

[0060] In addition, it was 39 F/g when the capacitor capacity at the time of using specific surface area of 1400m 2 / g for a positive electrode, and using 20mg of activated carbon fibers of specific surface area of 800m 2 / g for a negative electrode at a time was measured. It asked for the capacity factor based on this capacity. That is, drawing 4 is a graph which shows the inclination of change of the output capacitance according to change of the amount of the activated carbon fiber of a negative electrode.

[0061] the specific surface area of the activated carbon fiber used for a negative electrode -- about [of a positive electrode] -- one half of things -- even if -- even if according to about [fall] and drawing 4 it decreased the capacity as a capacitor until it became 70% about the rate of an use rate of the negative electrode to a positive electrode, it turned out that capacitor capacity does not fall.

[0062] (Example 7) The petroleum pitch system activated carbon fiber of specific surface area of 800m 2 / g, and 1400m2 / g was obtained like the <change of use and quantitative ratio of petroleum pitch system activated carbon fiber Mild from whom specific surface area of two poles differs> example 1. The jet mill ground this activated carbon fiber, and with a mean particle diameter of 20 micrometers activated carbon fiber Mild was obtained. Rolling out by the roll press, after adding and sheet-izing PTFE to this activated carbon fiber Mild like an example 5, in the thing from activated carbon fiber Mild of specific surface area of 800m 2 / g, the thing from activated carbon fiber Mild of 0.4mm, and specific surface area of 1400m 2 / g produced the sheet with a thickness of 1.0mm.

[0063] When the bulk density of the obtained sheet was measured, for specific surface area, the things from 800m2 / g are 0.8 g/cm3. It was the thing of high density. on the other hand -- the thing from 1400m2 / g -- 0.5 g/cm3 it was . These sheets were pierced circularly [the diameter phi of 15mm], the electrode from activated carbon fiber Mild of specific surface area of 800m 2 / g was used as the negative electrode, the electric double layer capacitor was made as an experiment by using the sheet from specific surface area of 1400m 2 / g as a positive electrode, and when capacitor capacity was measured, the value of 37 F/g was acquired. At this time, activated carbon fiber Mild's operating weight ratio used for the positive electrode and the negative electrode was positive-electrode:negative-electrode =1:0.6.

[0064] (Example 1 of a comparison) Activated carbon fiber Mild of specific surface area of 1400m 2 / g is used like an example 7, and they are 0.7mm in thickness, and bulk density 0.5 g/cm3. The sheet was

produced, it used for forward and negative-electrode two poles as the old conventional method, and the electric double layer capacitor was produced. At this time, activated carbon fiber Mild's operating weight ratio used for the positive electrode and the negative electrode was positive-electrode:negative-electrode =1:1. Although it was 1.4mm as well as the example 7, when the sum of the thickness of a positive electrode and a negative electrode measured capacitor capacity, there was 30 percent compared with 26 F/g and an example 6. [little]

[0065]

[Effect of the Invention] The electric double layer capacitor of this invention has a small specific surface area of the activated carbon material used for a negative electrode as compared with the existing electric double layer capacitor, and ends. The weight of the activated carbon material of a negative electrode is still better at about 70 percent of that of a positive electrode. Therefore, the negative electrode of a capacitor can be made into abbreviation one half extent in the volume as compared with the negative electrode of the conventional electric double layer capacitor. It became possible to make the volume of the whole capacitor small sharply by this.

[Translation done.]

* NOTICES *

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Various specific surface area of the activated carbon fiber used for the two poles at the time of aquosity electrolytic-solution use is changed, and change of the obtained capacitor capacity is shown in a graph.
[Drawing 2] Various specific surface area of the activated carbon fiber used for the two poles at the time of nonaqueous nature electrolytic-solution use is changed, and change of the obtained capacitor capacity is shown in a graph.
[Drawing 3] When the activated carbon fiber of the same specific surface area as two poles is used, it is the graph which shows the inclination of change of the activated carbon fiber proper amount of a negative electrode, and change of specific surface area.
[Drawing 4] It is the graph which shows the inclination of change of an output capacitance according to change of the activated carbon fiber proper amount of a negative electrode.
[Drawing 5] It is the mimetic diagram showing the typical structure of the electric double layer capacitor of this invention.
[Description of Notations]
1 Positive Electrode
2 Negative Electrode
3 Stainless Steel Lid
4 Stainless Case
5 Obturation Object
6 Separator
7 Electrolytic Solution

[Translation done.]

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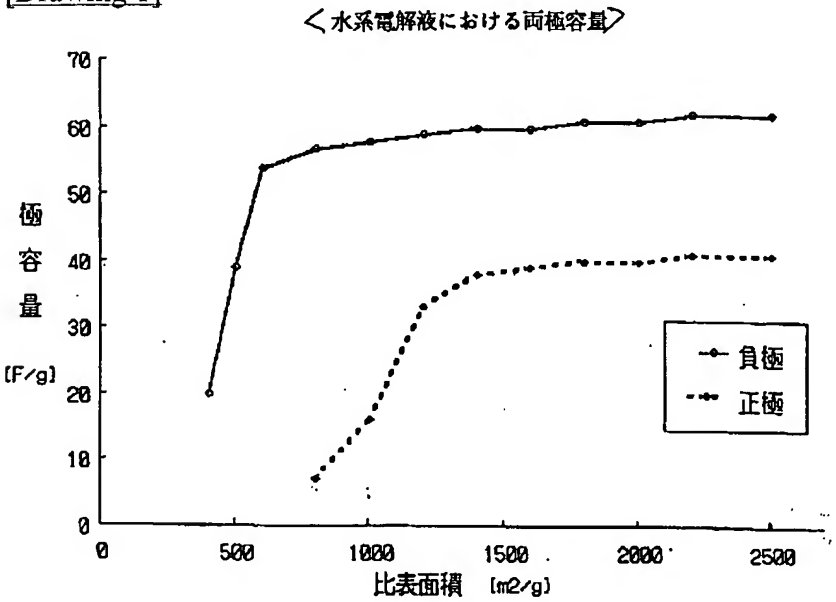
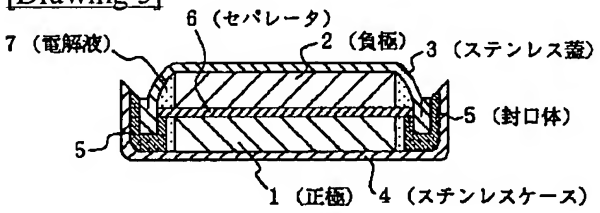
DRAWINGS

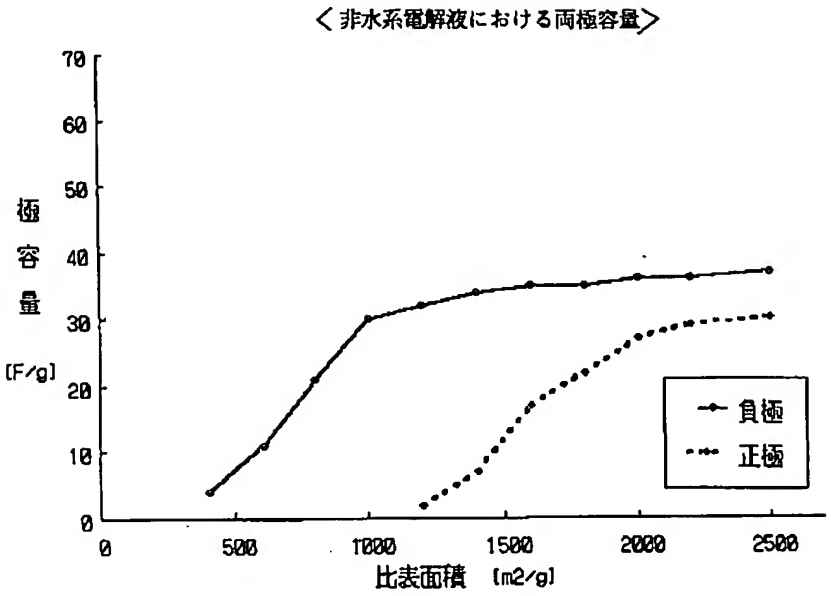
[Drawing 1]



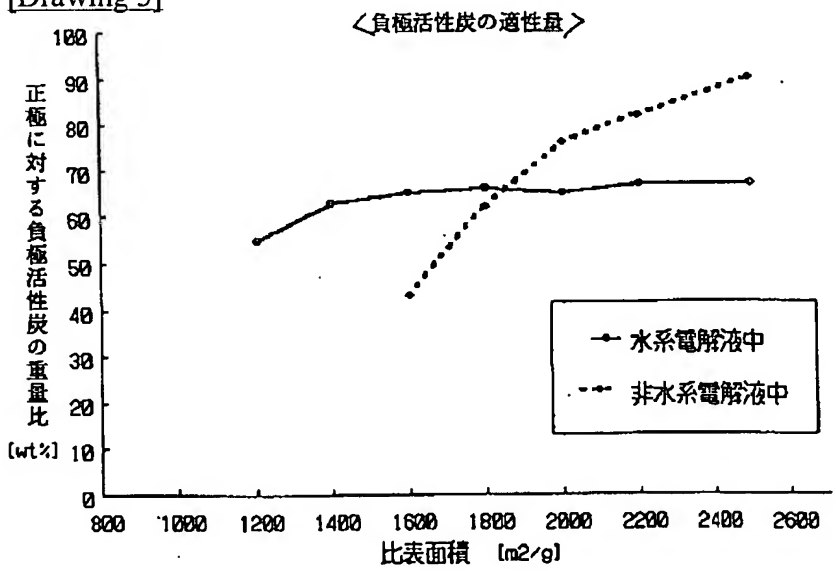
[Drawing 5]



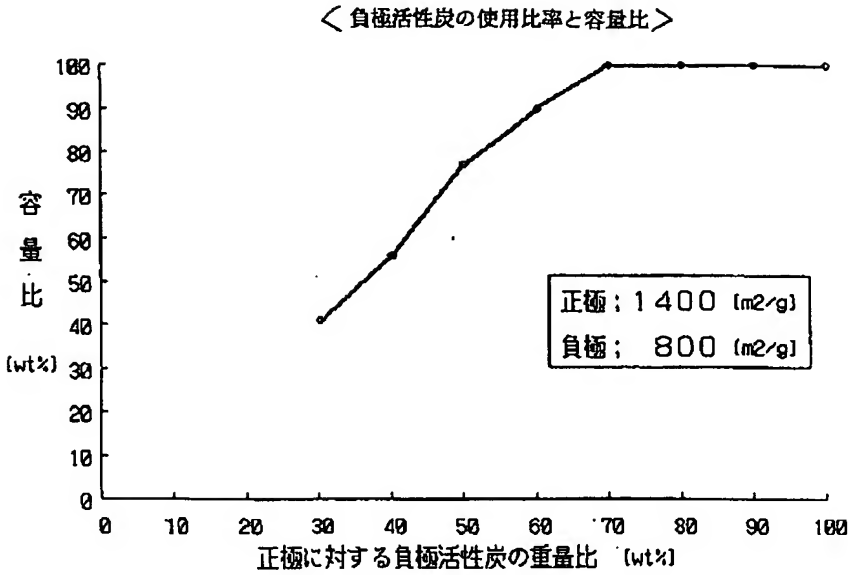
[Drawing 2]



[Drawing 3]



[Drawing 4]



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CLAIMS

[Claim(s)]
[Claim 1] The electric double layer capacitor characterized by the specific surface area of the activated carbon material which the specific surface area of the activated carbon material which the specific surface area of the activated carbon material which uses for a negative electrode the electrode which consists of activated carbon material in the electric double layer capacitor used for two poles uses for 500m2 / g-1500m2 / g, and a positive electrode is below 1000m2 / g-2500m2 / g, and is used for a negative electrode being smaller than the specific surface area of the activated carbon material used for a positive electrode.
[Claim 2] The electric double layer capacitor according to claim 1 characterized by activated carbon material being an activated carbon fiber.
[Claim 3] The electric double layer capacitor according to claim 1 or 2 with which the weight rate of the activated carbon material which uses for a negative electrode the electrode which consists of activated carbon material in the electric double layer capacitor used for two poles is characterized by being 0.4-0.9 to the activated carbon material used for a positive electrode.

[Translation done.]